# G.P. Assignment 2.

Q1) Given a 2D circle with radius 10 and center co-ordinate (1, 4). Apply the translation with distance 5 toword x axis & 1 toward y axis. obtain the new co-ordinates of C without changing it's radius.

→ Given old co-ordinates = (1, 4)
Translation vector = (5, 1)

C(x new, y new) = old co-ordinate + Translation vector

$= (1, 4) + (5, 1)$
$= (6, 5)$

New co-ordinate of center C = (6, 5)

Q2) Given the line segment with starting point as (0, 0) and ending point as (4, 4). Apply 30 degree rotation anticlockwise direction on-line segment and find out the new co-ordinate of the line.

→ Original object = $\begin{bmatrix} 0 & 0 \\ 4 & 4 \end{bmatrix}$

Transformation object = $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

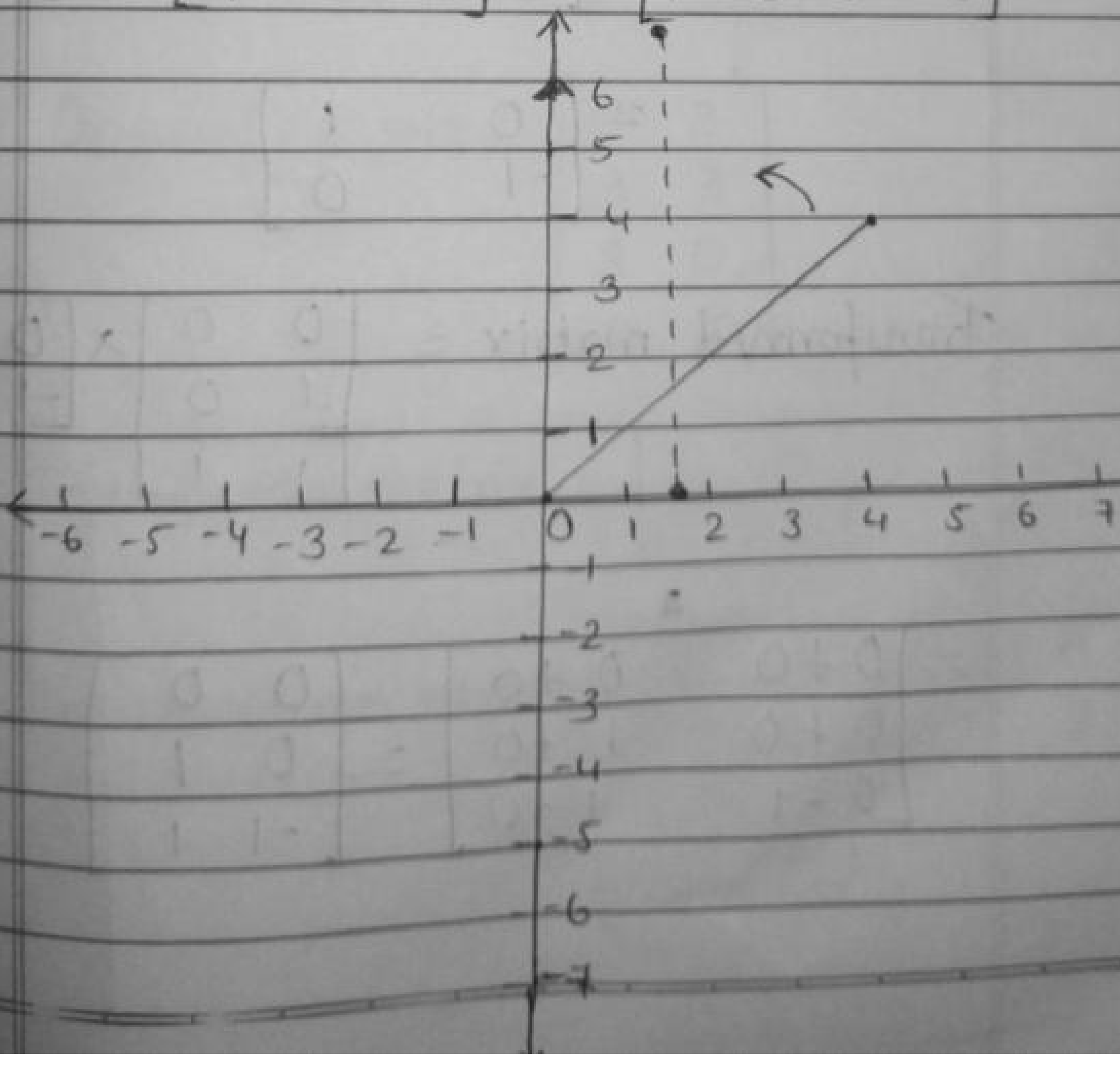
$$= \begin{bmatrix} \cos 30 & \sin 30 \\ -\sin 30 & \cos 30 \end{bmatrix}$$

$$= \begin{bmatrix} \sqrt{3}/2 & 1/2 \\ -1/2 & \sqrt{3}/2 \end{bmatrix}$$

$$\text{Transformed matrix} = \begin{bmatrix} 0 & 0 \\ 4 & 4 \end{bmatrix} \times \begin{bmatrix} \sqrt{3}/2 & 1/2 \\ -1/2 & \sqrt{3}/2 \end{bmatrix}$$

$$= \begin{bmatrix} 0+0 & 0+0 \\ 2\sqrt{3}+(-2) & 2+2\sqrt{3} \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 \\ \sqrt{3} & 4\sqrt{3} \end{bmatrix} \therefore = \begin{bmatrix} 0 & 0 \\ 1.732 & 6.928 \end{bmatrix}$$



Q3) Given a triangle with corner co-ordinates (0,0) & (1,0) & (1,1). Rotate the triangle by 90 degree anticlockwise direction and find out the new co-ordinates

→ Original Objects = $\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$

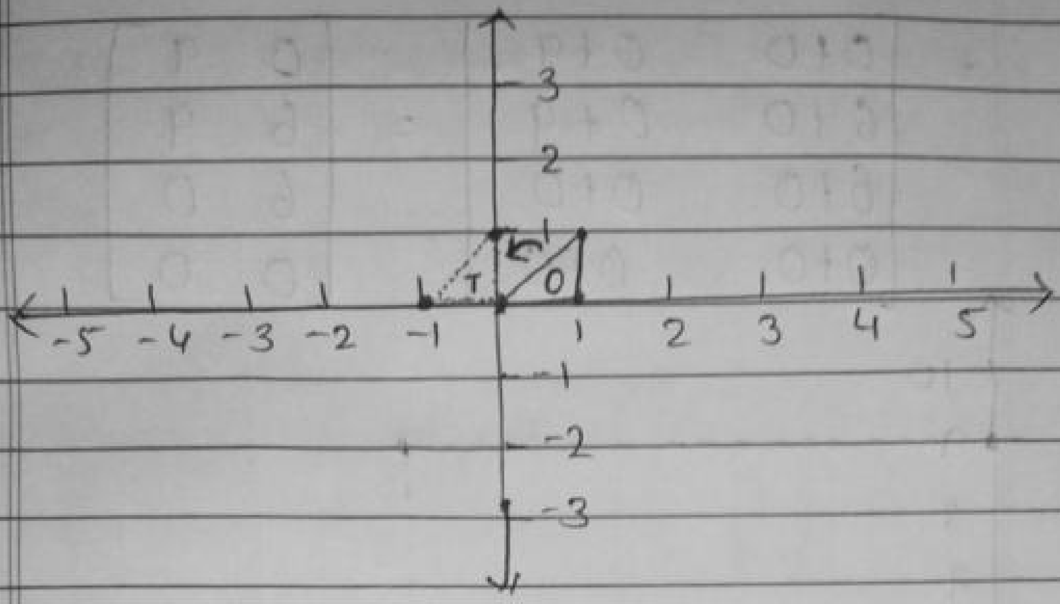
Transformed object = $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$

$= \begin{bmatrix} \cos 90 & \sin 90 \\ -\sin 90 & \cos 90 \end{bmatrix}$

$= \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

Transformed matrix = $\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

$= \begin{bmatrix} 0+0 & 0+0 \\ 0+0 & 1+0 \\ 0-1 & 1+0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}$



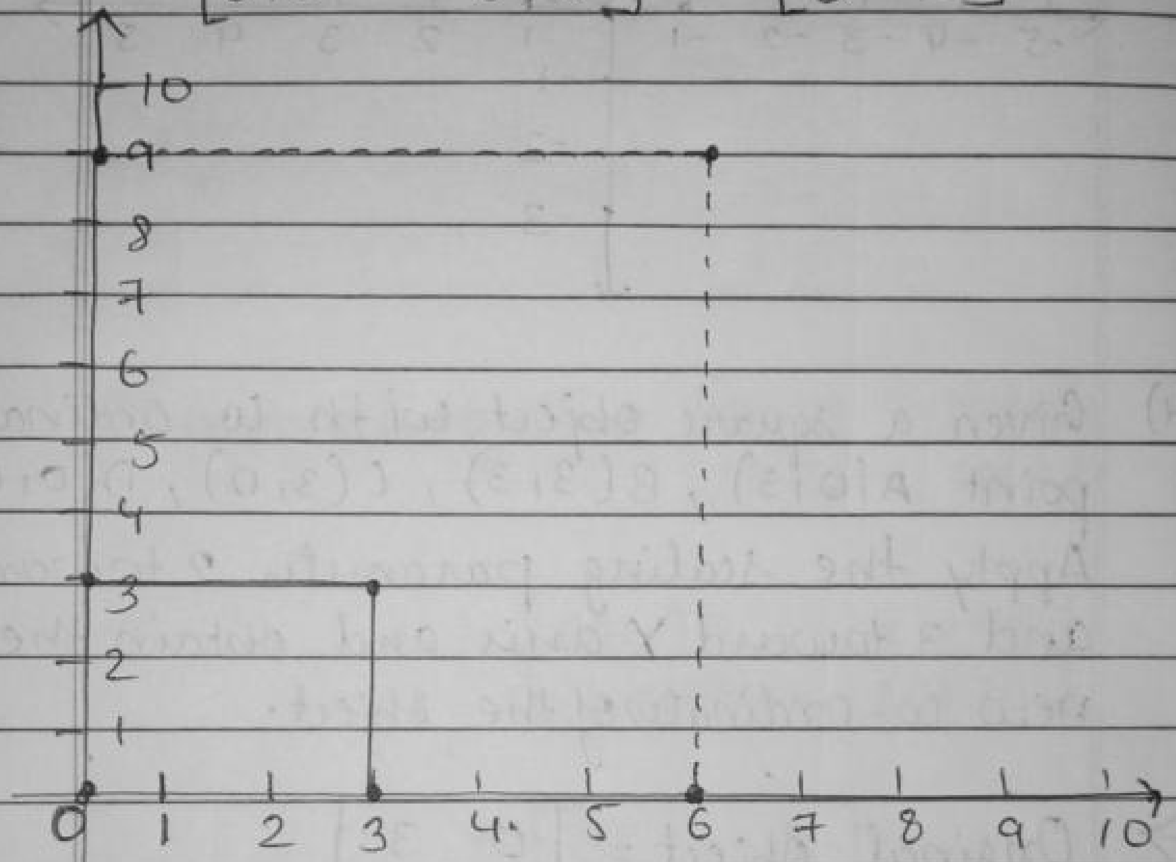
Q4) Given a square object with co-ordinates point A(0,3), B(3,3), C(3,0), D(0,0). Apply the scaling parameter 2 toward X and 3 toward Y axis and obtain the new co-ordinates of the object.

→ Original object = $\begin{bmatrix} 0 & 3 \\ 3 & 3 \\ 3 & 0 \\ 0 & 0 \end{bmatrix}$

Transformed matrix = $\begin{bmatrix} 2 & 0 \\ 0 & 3 \end{bmatrix}$

Transformed object = $\begin{bmatrix} 0 & 3 \\ 3 & 3 \\ 3 & 0 \\ 0 & 0 \end{bmatrix} \times \begin{bmatrix} 2 & 0 \\ 0 & 3 \end{bmatrix}$

$$= \begin{bmatrix} 0+0 & 0+9 \\ 6+0 & 0+9 \\ 6+0 & 0+0 \\ 0+0 & 0+0 \end{bmatrix} = \begin{bmatrix} 0 & 9 \\ 6 & 9 \\ 6 & 0 \\ 0 & 0 \end{bmatrix}$$




Q5) Given a triangle with co-ordinate points A(3,4) B(6,4) C(5,6). Apply the reflection on the x axis and obtain the new co-ordinates of the object.

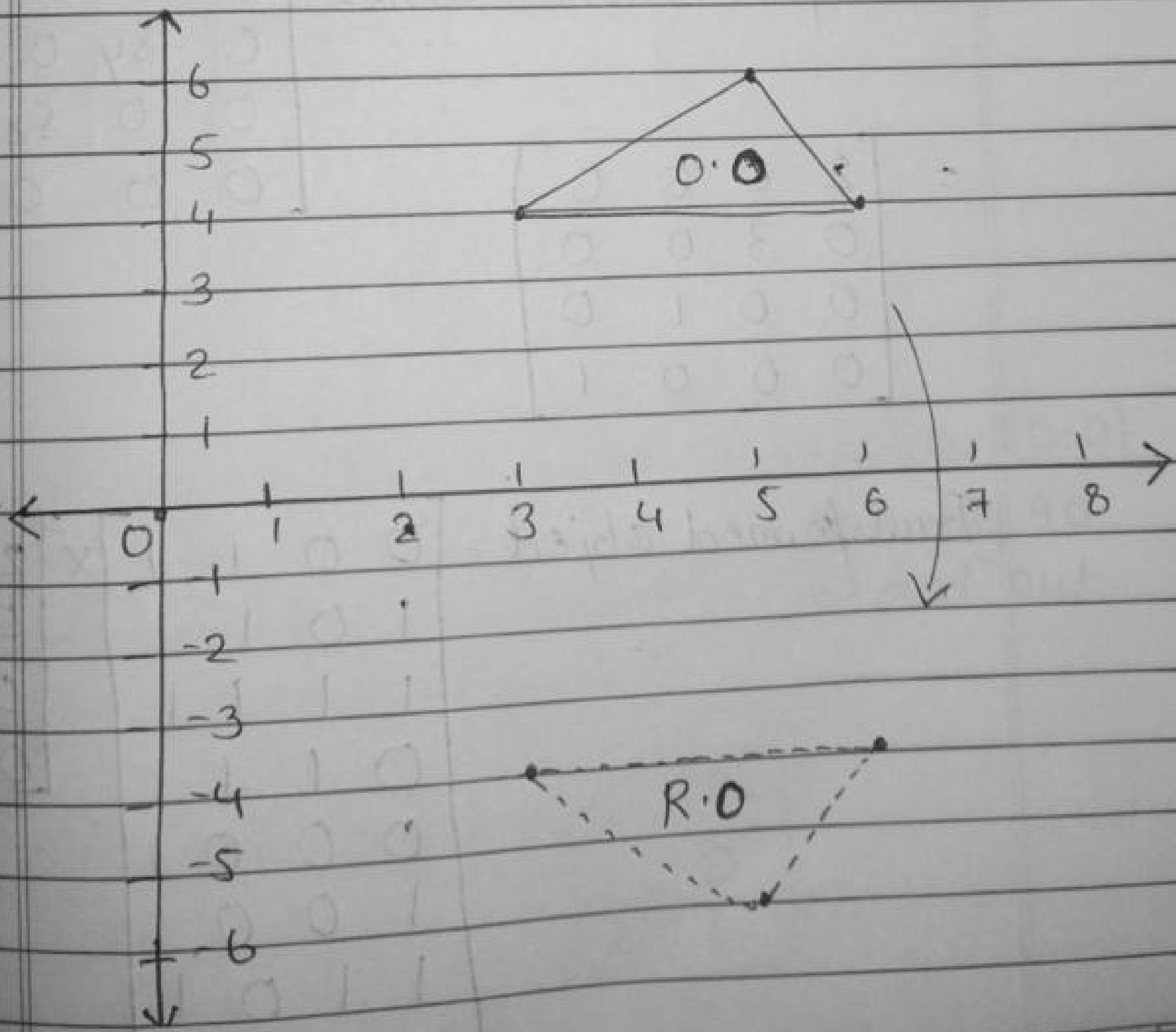
→ original object = $\begin{bmatrix} 3 & 4 \\ 6 & 4 \\ 5 & 6 \end{bmatrix}$

Reflection on X axis

Transformed matrix = $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

Transformed object = $\begin{bmatrix} 3 & 4 \\ 6 & 4 \\ 5 & 6 \end{bmatrix} \times \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

$= \begin{bmatrix} 3+0 & 0-4 \\ 6+0 & 0-4 \\ 5+0 & 0-6 \end{bmatrix} = \begin{bmatrix} 3 & -4 \\ 6 & -4 \\ 5 & -6 \end{bmatrix}$



Q6) Apply Scaling with factor 2, 3, 1 in X, Y, Z direction respectively on a unit cube

→ Matrix of original object = $\begin{bmatrix} 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 \end{bmatrix}$

Transformation matrix = $\begin{bmatrix} Sx & 0 & 0 & 0 \\ 0 & Sy & 0 & 0 \\ 0 & 0 & Sz & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$= \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

Transformed object = $\begin{bmatrix} 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$$\begin{bmatrix} 0+0+0+0 & 0+0+0+0 & 0+0+1+0 & 0+0+0+1 \\ 2+0+0+0 & 0+0+0+0 & 0+0+1+0 & 0+0+0+1 \\ 2+0+0+0 & 0+3+0+0 & 0+0+1+0 & 0+0+0+1 \\ 0+0+0+0 & 0+3+0+0 & 0+0+1+0 & 0+0+0+1 \\ 0+0+0+0 & 0+0+0+0 & 0+0+0+0 & 0+0+0+1 \\ 2+0+0+0 & 0+0+0+0 & 0+0+0+0 & 0+0+0+1 \\ 2+0+0+0 & 0+3+0+0 & 0+0+0+0 & 0+0+0+1 \\ 0+0+0+0 & 0+3+0+0 & 0+0+0+0 & 0+0+0+1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 1 & 1 \\ 2 & 0 & 1 & 1 \\ 2 & 3 & 1 & 1 \\ 0 & 3 & 1 & 1 \\ 0 & 0 & 0 & 1 \\ 2 & 0 & 0 & 1 \\ 2 & 3 & 0 & 1 \\ 0 & 3 & 0 & 1 \end{bmatrix} //$$

Q7) Given a triangle with co-ordinates (0,0) (1,0) (1,1). Rotate the triangle by 90 degree clockwise direction and find out the new co-ordinates

→ Original matrix = $\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$

Transformed matrix = $\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$

$= \begin{bmatrix} \cos 90 & -\sin 90 \\ \sin 90 & \cos 90 \end{bmatrix}$

$= \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$

Transformed object = $\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} \times \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$

$= \begin{bmatrix} 0+0 & 0+0 \\ 0+0 & -1+0 \\ 0+1 & -1+0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & -1 \\ 1 & -1 \end{bmatrix}$